Designation: F3322 − 18

Standard Specification for Small Unmanned Aircraft System (sUAS) Parachutes[1]

This standard is issued under the fixed designation F3322; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the design and manufacture requirements for deployable parachutes of small unmanned aircraft (sUA). This specification defines the design, fabrication, and test requirements of installable, deployable parachute recovery systems (PRS) that are designed to be integrated into a sUA to lessen the impact energy of the system should the sUA fail to sustain normal stable safe flight. Compliance with this specification is intended to support an applicant in obtaining permission from a civil aviation authority (CAA) to fly a sUA over people.

1.2 This specification is applicable to the design, construction, and test of deployable parachute recovery systems that may be incorporated into the system or structure, or both, of sUA seeking civil aviation authority (CAA) approval in the form of technical standard orders (TSO), flight certificates, flight waivers, flight permits, or other like documentation.

1.3 *Units*—The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *Federal Standards:*[2]

14 CFR Part 107 Small Unmanned Aircraft Systems

MIL-STD-1629A Procedures for Performing a Failure Mode, Effects, and Criticality Analysis

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *abstain, v*—before starting a particular test method, the unmanned aircraft (UA) manufacturer or designated operator shall choose to enter the test or decline to perform the test and any abstention shall be granted before the test begins.

3.1.1.1 *Discussion*—The test form shall be clearly marked as such, indicating that the manufacturer acknowledges the omission of the performance data while the test method was available at the test time.

3.1.2 *acceptable entanglement, n*—interaction of the parachute canopy, risers, or lines with the sUA that does not reduce the effectiveness of the parachute recovery system.

3.1.3 *applicant/proponent, n*—person or organization responsible for seeking the approval to operate and operating a small unmanned aircraft (sUA).

3.1.3.1 *Discussion*—The applicant/proponent may be one of the following entities: manufacturer, operator, or original equipment manufacturer (OEM).

3.1.4 *autonomous triggering system, ATS, n*—device or components independent from any flight critical system of the sUA that will detect and initiate parachute deployment upon detection of a critical failure of the sUA in flight.

3.1.5 *ballistic ejection, n*—ejection of the parachute recovery system into free air with the use of springs, pyrotechnic gas generators, or the use of inert gases or compressed air.

3.1.5.1 *Discussion*—Hazardous materials laws (for air transportation, for proper handling, storage, etc.) may apply

[1] This specification is under the jurisdiction of ASTM Committee F38 on Unmanned Aircraft Systems and is the direct responsibility of Subcommittee F38.01 on Airworthiness.

Current edition approved Sept. 1, 2018. Published September 2018. DOI: 10.1520/F3322-18.

[2] Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, http://www.access.gpo.gov.

when using hazardous materials such as pyrotechnic devices, cold gas generators, or compressed CO_2 for a ballistic parachute.

3.1.6 *bill of materials, BOM, n*—specific list of all components defined by this specification that make up the parachute recovery system.

3.1.7 *canopy filling/inflamation time, n*—time from canopy (line) stretch to the first full open canopy position.

3.1.8 *critical number motor failure, CNMF, n*—number of motors required to remove a sUA from stable flight. The subject motors shall be adjacent to one another in cases in which more than one motor is being tested. In the case of an odd number of motors, the number of "failure" motors shall be rounded up to the next even number. If the integrator can demonstrate that the sUA being tested with the PRS needs to have thrust cut from more motors than defined in the example below in order to remove the aircraft from stable flight it is up to the integrator to define the number of motors to reach CNMF. Refer to Section 6 for testing.

Examples of CNMF	4 Rotor	6 Rotor	8 Rotor
	Immediate Loss of Thrust on a minimum of one or more motors	Immediate Loss of Thrust on a minimum two adjacent motors	Immediate Loss of Thrust on a minimum of three adjacent motors

3.1.9 *declaration of compliance, n*—mechanism for thorough self-assessment and validation of compliance with this specification in which specific reporting or testing protocols are not listed.

3.1.9.1 *Discussion*—The integrator will keep documentation to support any declarations of compliance. The following information shall be retained on file at the manufacturer's facility for as long as systems remain in service: (*1*) technical data that defines the parachute recovery system's installation in the aircraft; (*2*) technical data that define the components, assemblies, and fabrication of the system; and (*3*) engineering analyses and test data prepared for qualification with this specification.

3.1.10 *demonstration, n*—a practical exhibition of how the PRS or components, or both, work.

3.1.11 *descent rate, n*—final steady state rate of decreasing vertical altitude of the sUA at sea level conditions.

3.1.11.1 *Discussion*—It shall be noted that horizontal speed and the calculation of horizontal impact should be considered based on the worst-case scenario but for the purpose of this specification it is not used as a determining factor. The horizontal impact can be influenced by the construction or deconstruction of the combination of wind or the pendulum effect, or both, both of which are greatly affected by the direction of travel and orientation of the sUA in relation to the PRS during deployment.

3.1.12 *energy measurement, n*—Kinetic energy is calculated as: $KE = 1/2\ mv^2$. Whereas "m" equals sUAs takeoff mass and "v" equals descent speed.

3.1.13 *entanglement, n*—unintended physical interaction of the parachute risers, lines, or canopy with the sUA during a PRS deployment that compromises the functionality and effectiveness of the PRS.

3.1.14 *flight-critical system, n*—system that, should it fail, will cause the sUA to no longer maintain stable flight.

3.1.15 *flight envelope, n*—range of combinations of speed, direction of travel, altitude, roll, angle of attack, and so forth within which the sUA is able to be safely operated without exceeding its structural design load factor.

3.1.16 *flight termination system, FTS, n*—device or components that will disable the propulsion system of the sUA.

3.1.17 *forebody, n*—object connected to the parachute canopy and accompanying drogue chutes, if applicable.

3.1.17.1 *Discussion*—The forebody shall be considered the sUA with any additional attachments (that is, parachute deployment system, payload, electronics, propellers, and so forth).

3.1.18 *full power failure/full power cut, n*—sudden and immediate loss of power function to the critical flight systems of the sUA such as motors, electronic speed controllers (ESC), and avionics.

3.1.18.1 *Discussion*—Throttling down the motors is not the same as a full power cut in a test as the former gives the operator control and advance knowledge that loss of stable flight is going to occur.

3.1.19 *inspection, n*—technique based on visual or dimensional examination of an element; inspection is generally nondestructive and typically includes the use of sight, hearing, smell, touch, and taste, simple physical manipulation, mechanical and electrical gauging, and measurement.

3.1.20 *integrator, n*—entity responsible for the integration of all the various parachute components, the sUA, and the testing of the entire system.

3.1.20.1 *Discussion*—The integrator could also be the parachute recovery system manufacturer or the sUA manufacturer. The integrator may also work with other named third parties to delegate various tasks. Tasks the integrator has are: (*1*) selection and integration of the parachute components, parachute deployment device, and any other electronics needed; (*2*) installation of the parachute recovery system on the sUA and working with the sUA manufacturer to integrate the system properly; (*3*) pulling together all the various component specifications to be sure they meet the requirements called out in this specification; and (*4*) performing and coordinating with a test facility all the various flight tests called out in this specification.

3.1.21 *manual triggering device, MTD, n*—device or component that can initiate deployment of the parachute recovery system at the discretion of the remote pilot in command (RPIC).

3.1.22 *manufacturer, n*—entity responsible for the creation of the various components of the parachute recovery system.

3.1.22.1 *Discussion*—These can consist of the parachute, parachute ejection device, flight termination system, parachute deployment controller, or other components. There can be any number of manufacturers.

3.1.23 *mean time between critical failure, MTBCF, n*—there are two criteria for reliability that are relevant for parachute recovery systems: (*1*) MTBCF for positive activation—the probability that the parachute recovery system including its ATS and FTS will open the parachute in case of emergency and (*2*) MTBCF for false positive event—the probability that the parachute recovery system will deploy unintentionally.

3.1.24 *minimum deployable altitude, MDA, n*—difference in altitude from the point of failure to the point of stabilized sUA descent under parachute; is airframe/speed dependent and certified through testing in Section 6.

3.1.25 *minimum flight altitude, MFA, n*—minimum altitude above ground level of the sUA in cases in which a parachute recovery system is used for flight over people. The MFA shall be defined per the results of testing in Section 6.

3.1.26 *opening shock load, n*—this is the maximum load force under any conditions that occurs on the main parachute during the process of the parachute opening.

3.1.27 *operational environment, v*—all allowed environmental conditions (temperature operating range, humidity range, dust and other debris tolerances, and so forth) that the manufacturer will define in the environmental envelope for operation/use for the product life of the parachute recovery system.

3.1.28 *packing/parachute packing, v*—process of folding and condensing the main canopy, connected cables, and other attached mechanisms to fit in a design compartment of the aircraft to hold the parachute.

3.1.28.1 *Discussion*—The packing process shall be done in such a fashion to allow for full deployment and acceptable opening behavior in the event of parachute deployment. Parachute packing procedures shall be defined by the parachute manufacturer in the PM.

3.1.29 *parachute, n*—any aerodynamic deceleration device designed to slow the descent of sUA when not under stable safe flight.

3.1.30 *parachute manual (PM), n*—the minimum material provided from the manufacturer to the operator/owner of the sUA that discusses topics such as instructions and procedures for inspection, maintenance, re-pack along with any PRS limitations in regard to operational or environmental limitations and approved payloads.

3.1.31 *parachute maximum dynamic shock load, MDSL, n*—maximum opening shock load force the parachute is rated for under any condition.

3.1.32 *parachute recovery system, PRS, n*—summation of the components of a parachute recovery system that work to reduce descent velocity.

3.1.33 *pilot chute, n*—smaller parachute than the main canopy that is connected to the main canopy.

3.1.33.1 *Discussion*—The main purpose of the pilot chute is to be deployed before the main canopy to pull the main canopy out of a container into free air to produce full canopy. The need for a pilot chute is determined by either the parachute manufacturer or the parachute recovery system integrator.

3.1.34 *Remote-Pilot-In-Command (RPIC)*—the person who: (*1*) has final authority and responsibility for the operation and safety of the flight; (*2*) has been designated as pilot-in-command before or during the flight.

3.1.35 *"shall" versus "should" versus "may", v*—use of the word "shall" implies that a procedure or statement is mandatory and shall be followed to comply with this specification, "should" implies recommended, and "may" implies optional at the discretion of the supplier, manufacturer, or operator.

3.1.35.1 *Discussion*—Since "shall" statements are requirements, they include sufficient detail needed to define compliance (for example, threshold values, test methods, oversight, and reference to other standards). "Should" statements are provided as guidance towards the overall goal of improving safety and could include only subjective statements. "Should" statements also represent parameters that could be used in safety evaluations and could lead to development of future requirements. "May" statements are provided to clarify acceptability of a specific item or practice and offer options for satisfying requirements.

3.1.36 *snatch force, n*—when using a pilot chute for parachute deployment, snatch force is the highest peak force needed to extract the parachute and risers from the holding canister/bay to deploy full canopy.

3.1.37 *stabilized descent, n*—the integrator shall determine the fall speed of the sUA when the PRS has deployed based on the sUA maximum takeoff weight. The descent is considered stabilized when the vertical descent rate is within 10 % of the integrator's specified fall speed at sea level conditions.

3.1.38 *supplier, n*—any entity engaged in the design and production of components used on a sUA.

3.1.38.1 *Discussion*—When the supplier is not the manufacturer, the supplier can only ensure that the components comply with accepted consensus standards.

3.1.39 *testing task or task, n*—activities well defined and specified according to an identified metric or an identified set of metrics for testing sUA parachute recovery systems and operators to perform for the sUA's parachute recovery system capabilities to be evaluated.

3.1.40 *trial, n*—number used to identify a test within a series of repetitions that a sUA is required to succeed in a standard verification method for the results to meet the required statistical significance.

4. Applicability

4.1 In this specification, designers and manufacturers of deployable parachutes for sUA shall find design references and criteria to use in designing, manufacturing parachutes, and parachute deploying systems with the intent of lessening the impact energy of the sUA in the instance that the sUA is unable to sustain operational flight.

5. Design Standards for Deployable Parachutes

5.1 *General:*

5.1.1 This section provides design criteria for deployable parachutes of sUA with the expectation that parachutes designed using this specification are designed to lessen the impact energy of the descending system for the purpose of enabling operations over people and persons not intended as part of the flight operations of the sUA.

5.1.1.1 The designers or manufacturers, or both, of the parachute recovery system may design the parachute recovery system to orient the sUA so that the sUA under canopy-aided descent is in an orientation that exposes the least risk to persons on the ground.

5.1.2 The manufacturer may produce a parachute recovery system for a sUA that is limited to the number of deployments. If the parachute recovery system is designed for a limited number of uses per a designated flight envelope, the manufacturer shall define the number of deployments before replacement is required in the PM.

5.1.2.1 Key components of the parachute recovery system shall be serialized by the manufacturer, so they can be traced to the end user (operator). Key information that should be kept by the manufacturer may include date of manufacture, product revision, and any quality assurance (QA) inspection information. Key components include: parachute, deployment device, deployment controller (electronics, FTS, ATS, MTD, and so forth), and other key components. Records shall be kept on customer or integrator sales and the serial numbers of the components delivered.

5.1.3 The parachute shall be sized to reduce residual energy of the sUA and may be combined with other energy reduction components such as airbags (including any attachments, parachute deployment system, payload, electronics, propellers, and so forth) with an attached parachute recovery system.

5.1.4 The PRS shall be designed to deploy successfully within the full flight performance envelope of the sUA once the sUA reaches its minimum deployable altitude.

5.1.5 This specification provides the minimum testing criteria for the installed performance according to the methods and measurement techniques that shall be provided by the manufacturer of the parachute recovery system to the operator/owner of the sUA.

5.1.6 The manufacturer shall define in the PM the process for preflight/post flight inspection of the parachute recovery system.

5.2 *Installation Design*—Each integrator of a sUA deployable parachute recovery system shall provide a general PM with documentation described in 3.1.30. The PM shall be used for all instructions and procedures for installation, arming, disarming, and maintenance of the parachute recovery system. The parachute recovery system shall be pre-packed and repacked per 5.2.1.

5.2.1 Parachute recovery systems approved for flight over people will be provided to the operator with the parachute pre-packed by the integrator or an authorized and approved third party. The integrator will approve third-party parachute packers. The integrator will specify both in the PM and on the parachute recovery system the service life of the packed parachute before it needs to be recertified, repacked, or replaced.

5.2.2 All components of the parachute recovery system shall be protected against loss of strength in service as a result of normal wear, operational environment, corrosion, contamination, and abrasion.

5.3 *Parachute Component Design Safety Factors:*

5.3.1 The parachute manufacturer shall provide a specification called maximum dynamic shock load (MDSL). The MDSL is used to qualify a parachute as being suitable for use at a given calculated opening shock load for the sUA and the given maximum deployment velocity. This is determined by a combination of measured and rated material strengths and measured strength of key canopy components such as the bridle, canopy shroud line connection break strength, and other critical parachute components in line from the bridle up to the canopy. The component having the lowest aggregated break strength of the parachute is the measured break strength. This value is then divided by two to give MDSL. The resulting MDSL will be ½ the measured strength of the parachute. Appendix X1 shows an example of an MDSL calculation done with OSCALC.

5.3.2 For main canopy parachutes, the parachute manufacturer-specified MDSL shall meet or exceed the calculated expected maximum opening force calculated for a given parachute recovery system as integrated into a sUA at maximum deployment velocity.

5.3.3 For all main risers (shock cords) of the parachute package, the design factor shall be based on the nominal strength of the materials used and the calculated maximum opening forces per 5.3.1.

5.4 *Main Canopy Design*—The main canopy dimensions and rate of descent shall be calculated using the following variables and equations:

5.4.1 *Main Canopy Nominal Diameter Equation:*

$$D_O = \sqrt{((S_O)/\pi)}(\text{ft or m}) \tag{1}$$

where:

D_O = nominal diameter of the parachute that is calculated by the total canopy surface area; S_O; and

S_O = total canopy surface area but shall not include vent holes and other openings seen in the canopy that are a part of the design (ft^2 or m^2).

5.4.2 *Main Canopy Rate of Descent Calculation (at Sea Level):*

$$vc_O = \sqrt{[(2\ W_T)/(S_O\ C\ (D_O)\rho_O)]}(\text{ft/s or m/s}) \tag{2}$$

where:

WT = total measured weight of the sUAS and parachute assembly (that is, parachute, risers, deployment system, holding canister, and so forth) (pounds or Newtons);

$C(D_O)$ = parachute drag coefficient related to S_O; measures the efficiency of drag force produced by the main canopy area; and

ρ_O = sea level air density (slugs/ft^3 or kg/m^3). For calculation, the nominal value to be used is 0.00238 slg/ft^3 (1.225 kg/m^3) at sea level and 59°F (15°C).

5.4.3 *Main Canopy Rate of Descent Calculation (at a Specific Altitude):*

$$vc = \sqrt{[(2\ W_T)/(S_O \quad C\ (D_O)\ \rho_O)]} \cdot 1 \sqrt{(\rho / \rho\ 0)} \text{(ft/s or m/s)} \quad (3)$$

where:

ρ = air density at a specific altitude; the air density measured above an altitude of 1000 ft (305 m) MSL shall be taken into account when calculating the descent velocity of a sUA in parachute-assisted return to earth (slugs/ft^3 or kg/m^3).

5.5 *Glide Slope and Vertical Velocity:*

5.5.1 The integrator may design the parachute deployment system to glide the sUA through descent.

5.5.2 For parachute operation using passive fill of the canopy (non-high energy active inflation), the parachute manufacturer should specify the filling distance of the canopy. Optional filling time can be provided and is rated at a specified velocity at canopy opening. These can be determined using the filling distance of parachute canopy equation:

$$sf = nD_P \quad (4)$$

where:

sf = filling distance of the parachute canopy;
D_P = parachute diameter at full inflation (ft or m); and
n = dimensionless fill constant defined by the type of main parachute canopy design used.

5.6 *Risers/Attachment Lines:*

5.6.1 The riser(s) attachment point shall be placed on the sUA so not to interfere with engine or propellers during in-flight operations or during deployment of the parachute.

5.6.2 The risers and other attachment lines shall not induce friction due to poor parachute packing to the rest of the canopy system during opening of the canopy.

5.7 *Designs and Precautionary Remarks for Deployment of Main Canopy:*

5.7.1 The opening of the parachute housing should be designed in such a way that, upon deployment, the parachute recovery system and connected risers shall not be caught on, damaged, or cut by blemishes, burrs, sharp edges, and any other defects that may cause interferences with proper deployment/inflation of the parachute recovery system. The parachute, risers or attachment lines, and lead lines shall be protected from abrasion during ejection/release and shall not entangle into the sUA in a manner that would render the parachute and sUA unable to descend at the defined descent rate.

NOTE 1—Although use of a FTS is required, there may be residual energy in recently killed motors that leave spinning propellers or "pinwheeling" propellers that create a hazard for parachute canopies and risers. Care shall be taken to avoid propellers or other control surfaces of the sUA.

5.7.2 The main canopy may be extracted with the aid of a pilot chute. If the main canopy is designed to be deployed with the aid of a pilot chute, then:

5.7.2.1 The pilot chute shall be held to the same design criteria seen in 5.3 – 5.7.

5.7.2.2 The pilot chute shall be designed not to interfere with the deployment process of the main canopy once the canopy has been extracted into free air unless the manufacturer has specified other intended uses for the pilot chute during descent.

5.7.3 The main canopy may be extracted with the aid of a ballistic ejection system. If the main canopy is designed to be deployed with the aid of a ballistic system, then:

5.7.3.1 The ballistic ejection system shall be controlled in such a manner as to not create a fire on the sUA.

5.7.3.2 The ballistic ejection system electronic signaling shall not interfere with the main electronic system of the sUA and shall not be affected by the expected operating environment (high-intensity irradiated field (HIRF) environment considerations).

5.7.3.3 If the parachute risers and harnesses connect to the sUA via the parachute ejection device, then the material strength of the ballistic ejection system attachment to the sUA and attachment points of the ballistic system shall be designed to be two times greater than the maximum opening shock load as calculated in 5.3.1. In any case, the connection strength of the parachute ejection device to the sUA shall be strong enough to accommodate the recoil force of the ballistic system when discharging the parachute and risers.

5.7.4 The integrator shall supply placards or labels for the exterior such that these placards or labels can be seen by first responders at accident or incident sites.

5.7.4.1 *Scope*—These placards or labels are to provide a visual warning to rescue or other personnel at the scene of an accident or incident in the event that the sUA involved is equipped with a ballistically deployed emergency parachute recovery system.

5.7.4.2 *Installation and Size of Placard or Label*—The parachute integrator shall permanently install the warning placards or labels on the parachute recovery system in a manner as specified below. For placards or labels that are required to be attached to the airframe, the sUA operator holds responsibility for visual placement of placards specified by this specification.

(1) Danger Placard—A triangular placard or label in which each side is at least 80 % the diameter of the largest circle encompassed by the largest projected surface shape of the PRS.

(2) The danger placard shall be placed adjacent to the parachute egress point for enclosed sUA in which the parachute recovery system may not be visible from the exterior. The integrator may include a QR code that leads to a web page that includes all the relevant information.

(3) The danger placard shall have the word "DANGER" and provide contact information for rescue personnel to seek help from the manufacturer and the type of ballistic deployment device (see proposed placard in Appendix X2).

(4) A danger placard shall be applied directly on any ballistic extraction device on aircraft that do not have the parachute recovery system inside the sUA airframe. This placard or label will warn rescue personnel in the event the ballistic device becomes separated from the sUA airframe at impact. Appendix X2 contains an example of such labeling.

5.7.4.3 *Label Size and Color*—All placards or labels shall follow the coloration methods described in the following.

(1) Danger Placard—Danger placards or labels shall be printed with a red border with white letters (or reverse type) and a descriptive graphic element (see proposed placard in Appendix X2).

(2) Identification Placard—Identification placards or labels shall be printed with a black border with orange letters surrounding an orange center with a descriptive graphic element (see proposed placard in Appendix X2).

(3) External placards or labels shall be printed using a reflective background material for enhanced visibility in low light or obscured conditions.

5.8 *Electronic System Considerations:*

5.8.1 All parachute recovery system electronics shall have a dedicated power source, such as a battery or capacitor, independent from the sUA's power supply(s). During a failure, this power source shall have enough energy to supply properly all connected electronics throughout a failure detection and descent. The independent power source may harvest charging power from the sUA.

5.8.2 All parachute recovery system electronics shall not interfere with operations of the sUA during normal flight. The parachute recovery system electronics may override the sUA's systems in the case that the sUA can no longer sustain safe flight.

5.8.3 The parachute recovery system shall be equipped with an autonomous triggering system (ATS) independent from any flight critical system of the sUA to deploy the parachute recovery system when a malfunction of the sUA is detected.

NOTE 2—The ATS can be integrated as part of the flight critical systems of the sUA instead of being an independent system if the integrator can demonstrate that the level of the sUA's system integrity is commensurate with industry standards recognized by the governing CAA for flight critical systems.

NOTE 3—If the ATS does not have a physical or electronic safety to prevent deployment while on the ground, then a warning shall be present in the PM that states when the motors are running and a critical failure occurs when the sUA is on the ground or on take-off/landing, that the ATS will allow the PRS to deploy which may present a ballistic/projectile hazard to personnel if they are in close proximity to the sUA during those phases of flight.

5.8.3.1 In the event of a deployment the PRS shall record the descent rate (descent rate shall be recorded as time vs altitude) and the method of deployment (ATS or MTD).

5.8.4 To prevent propellers from injuring people on the ground after a deployment the PRS shall also include a Flight Termination System (FTS).

5.8.4.1 The FTS shall activate at the time of or before parachute deployment is initiated.

5.8.5 The parachute recovery system shall be equipped with a manual triggering device (MTD).

5.8.5.1 The manufacturer may include a downlink system that allows the parachute recovery system to communicate to the RPIC.

5.9 *Maintenance and Continued Operational Safety Expectations:*

5.9.1 *Parachute Manual*—The manufacturer shall provide a parachute manual when providing the parachute recovery system to the operator of the sUA. The minimum contents of the parachute manual shall include the following topics here in this specification.

5.9.2 *Inspection Intervals and Criteria:*

5.9.2.1 *Intervals*—The manufacturer shall define in the PM the number or schedule or both of periodic inspection intervals that the owner/operator shall inspect the installed parachute recovery system.

5.9.2.2 *Criteria*—The manufacturer may offer inspection services to the operator for the defined inspection intervals. If the manufacturer allows for the operator/owner of the parachute recovery system to do their own inspections, the inspection criteria shall be defined in the PM with full explanations of how to recognize defects that could hinder normal operation.

5.9.3 *Maintenance Procedures:*

5.9.3.1 *Defects*—If the operator/owner of the parachute is to do their own inspections of the system, the manufacturer shall define maintenance procedures for the operator/owner to fix common defects impeding operation. If a defect found by the operator/owner is not covered in the PM or is too extensive for the operator/owner to repair on their own, the manufacturer shall provide information in the PM on how the operator/owner may return the parachute recovery system to the manufacturer for proper corrections or suggestions on following steps the operator/owner may take for a replacement parachute recovery system.

5.9.3.2 *Repacking*—For parachute recovery systems approved for flight over people the repacking method will be omitted from the PM and the manufacturer shall provide direction to the operator/owner in the PM on how to send the parachute or parachute recovery system, or both, properly to the manufacturer for repacking.

5.9.3.3 *Environmental Operating Limitations*—Any environmental factors that are outside of the functional capabilities of the PRS shall be clearly defined in the PM, including but not limited to: wind speed, temperature, humidity, altitude, and precipitation.

(1) Altitude/environment considerations shall be incorporated into the flight envelope of the PRS. Hot weather, high elevation, or heavy payload considerations, or combinations thereof, shall be taken into account when defining the operation limitations of the PRS and the manufacturer shall make these considerations known in the PM.

5.9.4 *Materials:*

5.9.4.1 *Fungus-proof Materials*—Materials that are nutrients for fungi shall not be used where it is practical to avoid them. Where such material is used and not hermetically sealed, they shall be treated with a fungicidal agent acceptable to the procuring activity; however, if they will be used in a hermetically sealed enclosure, fungicidal treatment will not be necessary.

6. Testing Standards of Deployable Parachutes

6.1 *General:*

6.1.1 *Testing Responsible Party*—The responsible party for testing the sUA with the PRS is the integrator. As defined in 3.1.20, the integrator could also be the parachute manufacturer, operator, or the sUA manufacturer. The integrator can work with the parachute manufacturer and the sUA manufacturer to tailor a test plan that covers the required items in this section.

6.1.2 *Examination of the Product*—Each PRS shall be inspected by a designated representative of the Third Party Testing Agency (TPTA) as defined in 6.3.1 to determine compliance with the requirements specified herein with respect to materials and markings that would satisfy safety requirements of this specification. A bill of materials (BOM) of the individual components in the full PRS shall be provided to the TPTA. The PRS presented to the TPTA for testing shall be wholly representative in materials, marking, construction and operational functionality of the final product of the PRS.

6.2 *Pre-Test Information Collection:*

6.2.1 *Date and Time of Test*—Give the testing date and time at which the test was started and completed; the test methods, when explicitly specified, can allow the tasks or repetitions to be distributed into multiple days. In the instance that testing occurs over multiple days, the date and time of each test shall be recorded.

6.2.2 *Facility*—Give name(s) of laboratory or test site where the test is to be conducted.

6.2.3 *Location*—Give name(s) of country, city, and state in which the test facility is located.

6.2.4 *Event/Sponsor*—Give a description of the party responsible for the test. If an event warrants the test, then a description of the event and purpose of test during the event shall be documented.

6.2.5 *sUAS Make/Model*—If the PRS is designed to work with a single sUA model, the sUAS model identification name/number and manufacturer name shall be documented. If the PRS is designed to work with several sUA models, each sUA model identification name/number and associated manufacturer name shall be documented. The PRS shall be designed per airframe and the integrator will list in the PM known configurations that the PRS is intended to work with. The integrator may list in the PM any configurations of the airframe that the PRS is known not to work with. A PRS certified for one type of sUA shall not be certified on another airframe without proper testing as defined in this specification. If the proposed aircraft is to be used for flight over people, then the PRS shall meet all applicable standards for flight over uninvolved third parties. If the PRS is designed to work with a single sUA model or controller, or both, for manual triggering, the sUA model identification name/number and manufacturer name shall be documented. If the PRS is designed to work with several sUA models or controllers, or both, for manual triggering, each sUA model or controller, or both, identification name/number and associated manufacturer name shall be documented.

6.2.6 *Organization*—Give the name of the organization with which the operator is associated; it could be the manufacturer of the PRS, manufacturer of the sUA, or the owner of the sUA. Also, provide full contact information of the organization (that is, address, telephone number, e-mail address, and so forth).

6.2.7 *Environment*—Conditions, under which the test will be conducted, including the light level, temperature, humidity, pressure altitude, and, if outside, the wind conditions. The test sponsor has the authority to specify these conditions.

6.2.8 *Trial Number*—Give the numerical sequence of the test being recorded. No trial number shall be reused in subsequent trials of the same parachute/sUAS configuration. If a sUA is tested for the first time, the trial number is 1 when the results are recorded. If the sUA is tested again, the trial number is 2 when the results are recorded on a separate test form and so on for each subsequent trial. If the sUA is tested with no results recorded, the trial number shall reflect a scenario in which "No Results Recorded" is documented and a description of why results were not recorded shall be provided, and testing can continue with the next sequential trial number.

6.3 *Third-Party Testing Agency (TPTA):*

6.3.1 *Third-Party Testing Agency (TPTA)*—The TPTA shall be a third-party agency or CAA approved delegate that oversees testing per this specification and produces a report containing the documentation and results of testing. This party is responsible for instigating failure modes during testing and collecting test data. The TPTA will provide the name or names of individuals from the TPTA participating in the trails and testing locations used for testing.

NOTE 4—For a PRS that is compliant with this specification to be used as part of an application to obtain permission from a CAA to fly a sUA over people in the form of technical standard orders (TSO), flight certificates, flight waivers, flight permits, or other like documentation, the TPTA should be an entity that is recognized by the governing CAA in which the operations are to take place.

6.3.1.1 *Instigation of Failure Commands*—In all failure scenarios, the failure command for the sUA shall be concealed from the RPIC, therefore avoiding anticipation of the test. The PRS signal for deployment, whether it is via a manual triggering device (MTD) or automatic (ATS), shall be conceived reactively to the instigated failure. In other words, the sending of the deployment signal cannot be anticipatory to the impending failure.

NOTE 5—Rigging of the failure can be performed by the PRS integrator at the approval of the TPTA.

6.3.1.2 *Independence of Failure Modes from the PRS*—Instigation of failure modes for testing shall be done independently of the PRS and its FTS and ATS.

6.3.2 *TPTA Report*—The integrator shall have the TPTA produce a report on the results of the trials.

6.3.3 *Minimum Contents of the TPTA Report*—The report produced by the TPTA shall clearly demonstrate the proven functionality of the PRS and include but not be limited to, the bill of materials (BOM) for the PRS that was tested, the minimum deployable altitude rating, as calculated in 6.4.2.9; the average rate of decent of the PRS, cumulative of all trials; and the results of all trials performed and related testing documentation pursuant to 6.3.4 and 6.4.

6.3.4 *Results by Videotaping*—All trails shall be documented by means of a continuous video recording that covers the aircraft takeoff, deployment of the PRS, and the landing after deployment.

6.4 *Testing Matrix and Requirements:*

6.4.1 The testing described in this section shall be the minimum number of tests to form a baseline in the aforementioned failure scenarios. Parachute manufacturers and PRS integrators are encouraged to provide additional data that pertain to any of these tests to provide better resolution to PRS recovery data.

6.4.1.1 Testing shall only be certified as having passed after the number of required tests are completed successfully without a PRS failure. If a failure of the PRS happens at any point during a specific failure scenario (FS), the integrator will then repeat the tests for that specific failure scenario (example FS 1.2) until the set of tests is completed without any failures after the test sponsor has evaluated and documented the reason of failure.

6.4.1.2 Testing shall be performed with five of the ten tests being performed at the minimum takeoff weight (MinTOW) with the PRS and the remaining five tests being performed at maximum takeoff weight (MaxTOW) with a manufacturer approved payload configuration.

6.4.1.3 Unless otherwise specified, a minimum of two tests by manual deployment (MTD) and tests by automatic deployment (ATS) for a total of ten tests of each failure scenario shall be conducted with no failure.

6.4.1.4 A properly simulated payload with correct CG may be substituted for a real payload in the maximum weight tests.

6.4.1.5 MTD deployments will have a minimum 2 s delay after the failure mode is initiated before the PRS is deployed. This delay will be timed and can be accomplished by either a manual trigger or timed delay of the ATS.

6.4.2 Testing of the PRS shall take place at maximum forward velocity of the aircraft and in a hover state (for rotorcraft) and additionally in a stalled state for fixed wing sUA in the failure scenarios presented in this section.

6.4.2.1 *Testing Matrix Table:*

Test Type	Multirotor	Single Rotor	Hybrid/VTOL	Fixed Wing
FS 1 Hover Full Power Cut	*FS 1.1* 1 MTD Test MinTOW *FS 1.2* 1 MTD Test MaxTOW *FS 1.3* 4 ATS Tests MinTOW *FS 1.4* 4 ATS Tests MaxTOW	*FS 1.1* 1 MTD MinTOW *FS 1.2* 1 MTD Test MaxTOW *FS 1.3* 4 ATS Tests MinTOW *FS 1.4* 4 ATS Tests MaxTOW	*FS 1.1* 1 MTD Test MinTOW *FS 1.2* 1 MTD Test MaxTOW *FS 1.3* 4 ATS Tests MinTOW *FS 1.4* 4 ATS Tests MaxTOW	FS 1 Not Applicable
FS 2 Hover CNMF Failure	*FS 2.1* 1 MTD Test MinTOW *FS 2.2* 1 MTD Test MaxTOW *FS 2.3* 4 ATS Tests MinTOW *FS 2.4* 4 ATS Tests MaxTOW	FS 2 Not Applicable	*FS 2.1* 1 MTD Test MinTOW *FS 2.2* 1 MTD Test MaxTOW *FS 2.3* 4 ATS Tests MinTOW *FS 2.4* 4 ATS Tests MaxTOW	FS 2 Not Applicable
FS 3 Full Forward Speed Full Power Cut	*FS 3.1* 1 MTD Test MinTOW *FS 3.2* 1 MTD Test MaxTOW *FS 3.3* 4 ATS Tests MinTOW *FS 3.4* 4 ATS Tests MaxTOW	*FS 3.1* 1 MTD Test MinTOW *FS 3.2* 1 MTD Test MaxTOW *FS 3.3* 4 ATS Tests MinTOW *FS 3.4* 4 ATS Tests MaxTOW	*FS 3.1* 1 MTD Test MinTOW *FS 3.2* 1 MTD Test MaxTOW *FS 3.3* 4 ATS Tests MinTOW *FS 3.4* 4 ATS Tests MaxTOW	*FS 3.1* 1 MTD Test MinTOW *FS 3.2* 1 MTD Test MaxTOW *FS 3.3* 4 ATS Tests MinTOW *FS 3.4* 4 ATS Tests MaxTOW
FS 4 Full Forward Speed CNFM Failure	*FS 4.1* 1 MTD Test MinTOW *FS 4.2* 1 MTD Test MaxTOW *FS 4.3* 4 ATS Tests MinTOW *FS 4.4* 4 ATS Tests MaxTOW	FS 4 Not Applicable	*FS 4.1* 1 MTD Test MinTOW *FS 4.2* 1 MTD Test MaxTOW *FS 4.3* 4 ATS Tests MinTOW *FS 4.4* 4 ATS Tests MaxTOW	If Applicable *FS 4.1* 1 MTD Test MinTOW *FS 4.2* 1 MTD Test MaxTOW *FS 4.3* 4 ATS Tests MinTOW *FS 4.4* 4 ATS Tests MaxTOW
FS 5 Shock Load Testing	~~*FS 5.1* 5 Tests at~~ MaxTOW ATS or MTD	~~*FS 5.1* 5 Tests at MaxTOW~~ ATS or MTD	~~*FS 5.1* 5 Tests at MaxTOW~~ ATS or MTD	*FS 5.1* 5 Tests at MaxTOW ATS or MTD
FS 6 Stall/Spin Failure	FS 6 Not Applicable	FS 6 Not Applicable	If Applicable 1 MTD Test MinTOW 1 MTD Test MaxTOW 4 ATS Tests MinTOW 4 ATS Tests MaxTOW	If Applicable 1 MTD Test MinTOW 1 MTD Test MaxTOW 4 ATS Tests MinTOW 4 ATS Tests MaxTOW
FS 7 Full Forward Flight Speed/Roll Failure	FS 7 Not Applicable	FS 7 Not Applicable	FS 7 Not Applicable	If Applicable *FS 6.1* 5 Tests at MaxTOW ATS or MTD
FS 8 Tail rotor/ directional control failure	FS 8 Not Applicable	*FS 8.1* 1 MTD Test MinTOW *FS 8.2* 1 MTD Test MaxTOW *FS 8.3* 4 ATS Tests MinTOW *FS 8.4* 4 ATS Tests MaxTOW	FS 8 Not Applicable	FS 8 Not Applicable
Minimum Number of tests per aircraft type	Minimum 45 Tests	Minimum 35 Tests	Minimum 45 Tests	Minimum 15 Tests

6.4.2.2 *All Rotorcraft (Single Rotor/Multi-rotor/Hybrid) sUA—Full Power Cut*—The aircraft shall experience a full power cut during maximum speed forward flight and in hover. As defined in 3.1.32 the PRS shall have independent power capability and deploy without entanglement.

6.4.2.3 *Critical Number Motor Failure—CNMF*—During CNMF testing the sUA shall have thrust instantaneously cut to the motors as defined in Section 3 in order to simulate a worst-case failure condition. In all scenarios, the PRS shall deploy and recover the aircraft without entanglement. CNMF testing shall be performed during maximum air speed forward flight and applicable in hover.

6.4.2.4 *Fixed-wing/Hybrid—Stall/Spin Failure*—The PRS shall be tested in a wing level forward stall unless the integrator determines that another type of stall is applicable to their sUA. The PRS shall be tested in stalled flight scenarios by means of the pilot intentionally inducing the stall conditions at a safe altitude. The PRS ATS shall automatically detect the applicable stall event and activate both the FTS followed by the deployment of the PRS. The ATS system shall deploy the parachute before a spin situation can occur. If the sUA has flight envelope protection built into the aircraft to prevent a stall from occurring, this test may be omitted.

6.4.2.5 *Fixed Wing—Full Forward Flight Speed/Roll Failure*—The PRS shall be tested at full forward flight speed (indicated air speed) in level flight and while in a maximum roll. A minimum of five manual or automatic deployment tests shall be performed at MaxTOW in level flight and roll scenarios. The direction of roll shall alternate with each test. If the sUA has flight envelope protection built into the aircraft to prevent a roll from occurring the maximum roll test may be omitted.

6.4.2.6 *Single Rotor—Tail Rotor/Directional Control Failure*—The PRS shall be tested in a tail-rotor failure state in which the single-rotor sUA has lost directional control and is starting to yaw about the main rotor axis. This test shall be performed at maximum forward flight speed (indicated air speed) and in a hover state. To simulate a tail rotor failure and the difficulty in initiating this failure, it may be initiated by setting the tail rotor to neutral pitch.

6.4.2.7 *Shock Load Testing*—Shock load testing shall be performed to verify that the parachute components are of adequate strength and that the sUA, or any attached equipment or payloads, do not separate from the sUA on parachute deployment. Shock load testing can be performed by Method A or B. The integrator is to determine and choose which method will reach the highest velocity for the aircraft and select that method. Method A – the aircraft is flown to maximum forward flight speed and then concurrently enters a maximum descent for two seconds before a full power cut is initiated. Method B – a full power cut at hover shall be performed and the aircraft will free fall for three seconds before the PRS is deployed so that the sUA approaches terminal velocity. All shock load testing will be performed with the sUA configured at its maximum takeoff weight. This test shall be repeated five times.

6.4.2.8 *Minimum Deployable Altitude Testing*—Minimum deployable altitude testing shall be performed concurrently to forward flight and hover testing in both critical number motor failure and full power failure testing where applicable to the aircraft type. Onboard instrumentation shall verify the altitude at which the failure scenario commences, and the minimum deployable altitude shall be recorded as the difference in height from the altitude at which the failure scenario commences, to the altitude at which the vertical descent speed stabilizes after parachute deployment per 3.1.37.

6.4.2.9 *Minimum Deployable Altitude Rating*—The minimum deployable altitude of the PRS will be determined by the greatest recorded difference during all automatic deployments, plus two times the full length of the parachute assembly.

6.4.2.10 *Rate of Descent Testing*—The rate of descent data of the sUA shall be recorded during the trials. Data shall be recorded to determine the average rate of descent of the PRS, cumulative of all trials.

6.4.3 With the addition of payload or other mass changes to the forebody of the sUA, maximum weight thresholds shall be considered in the flight envelope of the PRS defined by the manufacturer in the PM.

6.4.3.1 *Payload Alterations After Testing*—It is up to the integrator to self-certify (declaration of compliance) that any payload alteration no matter how small will not prevent the PRS from working as intended.

6.4.4 To give a better overview of the PRS's reliability, the system may be tested by an external authorized institution that will analyze the PRS including all of its components: parachute, canister, ATS and FTS, and state its MTBCF according to the Failure Mode Effect and Criticality Analysis (FMECA) process in accordance with guidelines of MIL-STD-1629A or equivalent. This is not to be a replacement for functionality testing of the PRS.

6.5 *Parachute Component Testing*—The following tests are all performed on the parachute components as used on the final assembly in the sUA for flight over people.

6.5.1 *Parachute Component Testing to Determine the Parachute-rated MDSL:*

6.5.2 The shroud line material that connects between the parachute bridle and the canopy shall be strength tested in suitable testing machines to determine the parachute maximum load strength. The aggregate strength of all shroud lines will be the calculated strength for the shroud lines. For example, if a nylon shroud line is rated at 400 lb (1779 N), and there are twelve shroud lines for the parachute, the aggregate strength of the shroud lines is 4800 lb (21 351 N). If the manufacturer of the shroud line material provides certified strength rating of these components, then the certified ratings may be used.

6.5.3 Shroud line sewn connections to the canopy shall be tested to determine the break strength of the connection. The aggregate strength of all shroud line connections will be the calculated strength for the line connections. For example, if a nylon shroud line connection strength to the canopy is measured at 375 lb (1668 N), and there are twelve shroud lines for the parachute, the aggregate strength of the shroud line connections is 4500 lb (20 017 N).

6.5.4 If used, the parachute bridle is the component that provides the singular point of connection for all shroud lines to the main riser. The bridle strength shall be tested on a suitable testing machine to determine the break strength of the bridle. For example, the break strength of the bridle could be measured as 2200 lb (9786 N).

6.5.5 The overall parachute component MDSL will be the lesser value of the strength values of 6.5.2 through 6.5.4 and this value is then divided by two. For example, if we have: 6.5.2—4800 lb (21 351 N), 6.5.3—4500 lb (20 017 N), and 6.5.4—2200 lb (9786 N), the parachute-rated MDSL is 2200 lb (9786 N)/2 = 1100 lb (4893 N).

6.6 *Parachute Riser and Other Rigging Testing:*

(1) Main Riser (Shock Cord) and Other Connectors (Quick Links or Other Connectors) that Connect Between the Parachute Bridle and the Harness Assembly (If Used)—The riser components that connect the parachute bridle to the body or harness assembly of the sUA shall be strength tested to the load defined by the use of the safety factors of two over the maximum opening shock load as determined in 5.3.1 and using the same connectors to be used in the final attachment installation on the sUA for flight operations. If a manufacturer-provided strength rating is given for these components, then these ratings may be used.

(2) If used, the harness assembly connects the main riser to the sUA body. The harness may provide a multi-point connection to keep the sUA level upon descent. The harness assembly

may consist of additional short shock cords and possibly other connectors such as quick links. Finally, these connect to one or more hard points on or inside the sUA body. All components that attach the main shock cord to the exterior or within the interior structure of the sUA shall be tested to ensure that the riser material and connectors' shear strength are sufficient such that the PRS is not separated from the sUA during the opening shock transferred to the sUA as defined in 5.3.1. If a manufacturer-provided strength rating is provided for these components, then these ratings can be used.

6.6.1 All items of the parachute release/ejection and controls system shall be bench tested for proper functionality under similar conditions to be seen in the flight operations. Such conditions include vibration, pressure, temperature, shock/g-loading, and position of the system relative to the sUA that are likely to be encountered by the sUA during lost-link flight conditions, loss of flight, emergency landing conditions, or air-brake operations, or combinations thereof. Environmental factors, such as, but not limited to, moisture, salt, fog, sand, and dust, shall be considered as possible conditions that can be seen during flight operations, and the manufacturer shall define what environmental considerations are appropriate for parachute use.

6.6.2 The electronic systems/links between the PRS and the operating system of the sUA should be designed to not allow the PRS to damage, jam, or prematurely deploy the parachute canopy and parachute accessories inadvertently. This does not apply to manual deployments.

6.6.3 If the PRS operates in an "armed" configuration, the system shall be tested for correct deployment when the system is set to the "armed" configuration. The integrator shall define the process to arm and disarm the system to prevent accidental deployment.

6.6.3.1 If the PRS is equipped with an arming/disarming system, the manufacturer shall include in the PM a pre-flight process that allows for safely arming the system. The PRS shall also have a way to disarm safely in the case that the aircraft is not in normal flight procedures (that is, at rest with no intent of flying, crashed without parachute, and so forth). The manufacturer should include a systematic feedback loop to the RPIC in the case that the sUA is flying but the parachute is not available for successful deployment.

6.6.4 If the parachute extraction system includes a ground release mechanism, the ground release mechanism shall be tested for operation under conditions of low-ground contact shock and high surface winds such that the sUAS does not become airborne again after parachute-aided descent.

7. Keywords

7.1 design; flight over people; parachutes; small unmanned aircraft system; sUA; testing

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLE OF MDSL CALCULATION DONE WITH OSCALC

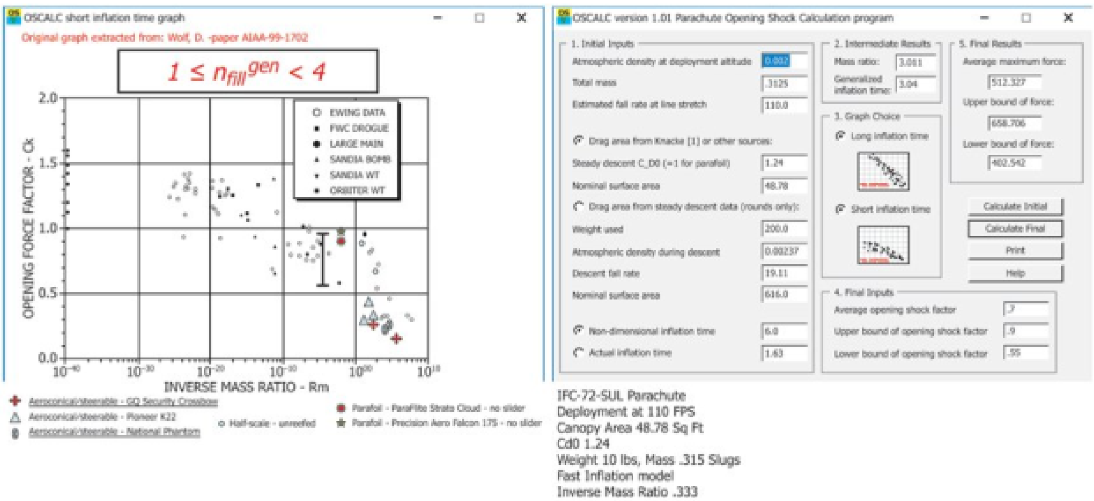

FIG. X1.1 Example of MDSL Calculation Done with OSCALC

X2. SAMPLE OF DANGER AND WARNING LABELS (PLACARDS)

FIG. X2.1 Sample of Danger and Warning Labels (Placards)

SUPPLEMENTARY REQUIREMENTS

S1. Retained Data

S1.1 Integrators may declare compliance with this specification upon successfully meeting the requirements of all sections of this specification. The following information shall be retained on file by the integrator and applies for as long as the PRS remains in service.

S1.1.1 Engineering analysis and test data requirements to comply with the design standards for deployable parachutes, as outlined in Section 5.

S1.1.2 The report produced by the TPTA, as outlined in 6.3.3.

S1.1.2.1 Bill of materials (BOM) that matches the BOM that was provided in the TPTA report, as outlined in 6.3.3, any difference in the BOM shall be noted and an explanation shall be provided.

S2. Delivered Data

S2.1 The following is the recommended minimum documentation that a governing civil aviation authority (CAA) may look to review when an applicant is seeking to use a PRS as a part of an application to meet certification or airworthiness requirements, or both, for a particular country or area under the jurisdiction of a CAA to fly a sUA over people. The following information is intended to provide a clear path of the requirements in regards to testing and validation documentation of the PRS that an integrator will need to provide an applicant to be compliant with this specification.

S2.1.1 Engineering analysis and test data requirements to comply with the design standards for deployable parachutes, as outlined in Section 5.

S2.1.2 The report produced by the TPTA, as outlined in 6.3.3.

S2.1.2.1 Bill of materials (BOM) that matches the BOM that was provided in the TPTA report, as outlined in 6.3.3, any difference in the BOM shall be noted and an explanation shall be provided.

S2.1.3 Parachute manual, as outlined in 3.1.30.

S2.1.4 If hazardous materials such as pyrotechnic devices, cold gas generators, or compressed CO_2 for a ballistic parachute are used in the ballistic ejection of the PRS, the integrator shall provide the applicant all regulatory compliance documentation pursuant to the related laws of the particular country or area under the jurisdiction of a CAA the applicant is applying to, as outlined in 3.1.5.

S2.1.5 As of the published date of this specification, not all Civil Aviation Authorities (CAAs) have defined the impact kinetic energy values, safe energy levels, or acceptable human injury thresholds that an integrator or applicant intending to obtain permission from a CAA to fly a sUA over people may use for the testing and validation of their PRS. In the absence of a defined impact kinetic energy value, safe energy level, or acceptable human injury threshold, the applicant may propose to the governing CAA, an impact energy measurement level that it deems acceptable.

S2.1.5.1 The applicant shall include all assumptions of their proposed energy measurement threshold recommendation in their documentation package, in addition to the documentation requirements included in this specification.

S2.1.6 Applicants who can demonstrate a need to bypass a specific requirement in this specification may request relief from the governing CAA.

BIBLIOGRAPHY

(1) Department of Defense JSSG-2010-12, Deployable Aerodynamic Decelerator (DAD) Systems Handbook

(2) FAA Special Conditions 23-ACE-76 (Docket No. 118C), Ballistic Recovery Systems, Modified for Small General Aviation Aircraft